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WOODY, C. O. Florida Power & Light Co.
RECIP. NAME RECIPIENT AFFILIATION
THADANI, A. C. PWR Project Directorate 8

SUBJECT: Application to amend License NPF-16, deleting License Condition 2.C.19 to permit discharge of fuel at end of Cycle 3 operation listed limits. Approval requested by 870501. Justification encl.

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FLORIDA POWER & LIGHT COMPANY

APR 2 1 1986

L-86-173

Office of Nuclear Reactor Regulation
Attention: Mr. Ashok C. Thadani, Director
PWR Project Directorate #8
Division of PWR Licensing - B
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Thadani:

Re: St. Lucie Unit No. 2
Docket No. 50-389
NPF-16 License Condition 2.C.19

In accordance with 10 CFR 50.90, Florida Power & Light Company (FPL) submits herewith three signed originals and forty copies of a request to delete License Condition 2.C.19 from Facility Operating License NPF-16. License Condition 2.C.19 requires FPL to submit and obtain NRC approval of a new analysis that addresses potential gas-gap releases for extended burnup fuel.

The attached analysis presents the analytical methods and results for radioactive fission product activity in the fuel rod gas gap for extended burnup fuel (> 38,000 MWD/MTU). This report shows that the results of the FSAR gas-gap-activity analysis are conservative for fuel assembly burnups out to 60,000 MWD/MTU. FPL requests NRC approval of the attached analysis and deletion of License Condition 2.C.19 in order to permit discharge of fuel at the end of Cycle 3 operation that may exceed 38,000 MWD/MTU. Approval is requested by May 1, 1987.

The proposed license amendment has been reviewed by the St. Lucie Facility Review Group and the Florida Power & Light Company Nuclear Review Board.

In accordance with 10 CFR 50.91(b)(1), a copy of the proposed amendment is being forwarded to the state designee for the State of Florida. FPL Check No. 1066 is attached as remittance of the fee specified in 10 CFR 170.21.

Very truly yours,

C. O. Woody
Group Vice President
Nuclear Energy

COW/MAS/gp
Attachments
cc: Dr. J. Nelson Grace, USNRC, Region II
Mr. Allan Schubert, Florida Dept. of Health & Rehabilitative Services
Harold F. Reis, Esquire, Newman & Holtzinger

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1 1

RJS4/006/1

STATE OF FLORIDA)
) ss.
COUNTY OF DADE)

C. O. Woody, being first duly sworn, deposes and says:

That he is a Group Vice President of Florida Power & Light Company, the licensee herein;

That he has executed the foregoing document; that the statements made in this document are true and correct to the best of his knowledge, information, and belief, and that he is authorized to execute the document on behalf of said Licensee.

C. O. Woody

Subscribed and sworn to before me this
21 day of April, 1986.

Denise M. Galvis
NOTARY PUBLIC, in and for the County of Dade, State of Florida.

My commission expires: NOTARY PUBLIC STATE OF FLORIDA
MY COMMISSION EXP SEPT 18,1989
BONDED THRU GENERAL INS. UND.

Safety Evaluation for a Proposed Change to the St. Lucie Unit 2 Operating License on Maximum Assembly Discharge Burnup.

I. Introduction

The purpose of this evaluation is to address License Condition 2.C.19, which states that:

> "Prior to storing extended burnup fuel in the modified spent fuel pool (greater than 38,000 Mw-days/Metric ton) the licensee must submit and obtain approval of a new analysis that addresses the potential of large gap releases for the extended burnup fuel."

This license condition was introduced as a result of the NRC's review of the fuel storage rack analysis that CE provided for St. Lucie Unit 2 (Reference 1). The NRC stated that the fission gas releases being calculated by the various industry fuel performance models available at that time, did not bound data the NRC had which indicated fission gas releases at high burnups well in excess of the 10% specified in the Standard Review Plans. As a result, during the review of the re-rack submittal, the staff identified a concern regarding the impact of high burnup fuel gas gap releases resulting from a fuel handling accident. To address this concern, FPL contracted Combustion Engineering to perform a safety analysis in order to demonstrate that the extended burnup fission gas release was bounded by the FSAR gas gap activity analysis. The results of that analysis are discussed in the next section of this report.

II. Safety Evaluation

The safety analysis performed in support of the proposed deletion of License Condition 2.C.19 can be found in attachment 2. The main emphasis of the analysis was to calculate the release fraction of I-131, which is the controlling isotope, at high burnup regimes (>38,000 MWD/MTU) and to compare the resulting value to that assumed in the FSAR. The FATES3A code was used in conjuction with the ANSI/ANS-5.4 standard to calculate fuel temperatures (Figure 2) and release fractions for various burnup regimes. In addition, a rod power history (Figure 1) which is typical of St. Lucie Unit 2 and is expected to generically bound the fuel rod power history for future cycles, was used in this analysis.

Table 2 lists the release fractions at an exposure of 43,396 MWD/MTU. The calculated release fraction of 3.64×10^{-2} in conjuction with a lower I-131 inventory than

that used in the FSAR (due to the lower 8.38 kw/ft rating used in this analysis - Figure 1), results in a reduction of the I-131 source term to an equivalent release fraction of 3.02×10^{-2}. This release fraction is approximately 3 times less than the FSAR assumed source term (10%). The higher kw/ft rating used in the original FSAR analysis (10.08 kw/ft) was overly conservative due to the fact that at the time the FSAR analysis was performed, it was not clear what the fuel management plans or operating strategies would be beyond Cycle 1.

Additional fission gas release calculations performed at burnups of 52,380 MWD/MTU and 60,000 MWD/MTU indicate that the release fractions decrease with increasing burnup. In particular, the release fractions at these higher burnups, which are shown on Tables 3 and 4, are about a factor of 23 smaller than the value quoted in the FSAR. This effect is due to the decreasing linear heat rate as a function of increasing burnup. Based on the foregoing discussion, it is concluded that the existing St. Lucie Unit 2 gas gap activities conservatively bound the gas gap activities for fuel assembly burnups out to 60,000 MWD/MTU. Finally, the No Significant Hazards Evaluation for this proposed License Amendment can be found in Attachment 1.

References

1. Proposed License Amendment - Spent Fuel Pool Rerack, St. Lucie Unit 2 Docket No. 50-389, March 13, 1984.

2. Letter J. L. Perryman (FPL) to F. Z. Stiteler (CE), "St. Lucie Unit 2 Extended Burnup Gas Gap Activity Release", FRN-85-193, July 9, 1985.

3. Letter E. L. Trapp (CE) to J. L. Perryman (FPL), "St. Lucie Unit 2 License Condition 19 on Extended Burnup Fuel Gas Gap Activity Release", F2-CE-R-036, October 1, 1985.

ATTACHMENT I

NO SIGNIFICANT HAZARDS EVALUATION

NO SIGNIFICANT HAZARDS CONSIDERATION

The requested amendment to the St. Lucie Unit 2 operating license deletes License Condition 2.C.19 which limits the burnup of fuel stored in the spent fuel pool to 38,000 MWD/MTU. An evaluation of this request has been performed to demonstrate that no significant hazards consideration exists, based on a comparison with the criteria of 10CFR50.92 (C).

The following evaluation demonstrates (by reference to the analysis contained in the attached Safety Analysis Report) that the proposed amendment to remove License Condition 2.C.19 does not exceed any of the three significant hazards consideration standards.

1. The requested change does not increase the probability or consequences of accidents previously analyzed. Since the configuration of the plant and the mode of operation remain unchanged, the probability of accidents previously analyzed remains unchanged. In addition, as described in the attached safety analysis report, the radiological consequences of a fuel handling accident, whose results would be affected by increasing the assembly burnup beyond the current 38,000 MWD/MTU limit, are bounded by previous FSAR analysis. In particular, the analysis findings indicate that the I-131 gas gap release fractions decrease with increasing burnup and that the release fractions are a factor of about twenty-three (23) smaller than the FSAR source term for an assembly burnup of 60,000 MWD/MTU. Based on these findings, the proposed deletion of License Condition 2.C.19 does not involve any increase in the probability or consequences of an accident previously evaluated.

2. The requested change does not increase the potential for accidents different from any accident previously considered because the plant configuration and the manner in which it is operated remain the same. In particular, the proposed change does not constitute any change in the procedures for plant operation or hardware and therefore will not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The requested change does not reduce the safety margin because it has been shown in the safety analysis that the calculated release fraction for the controlling isotope is significantly lower than the release fraction assumed in the St. Lucie Unit 2 FSAR. Since the results are bounded by the FSAR fuel handling analysis, the proposed change

to delete the 38,000 MWD/MTU burnup limit will not involve a reduction in a margin of safety.

The proposed amendment is similar to example (iv), presented in the staff guidance for determination of no significant hazards amendments (48 FR 14870 dated April 6, 1983), of amendments not likely to involve significant hazards considerations:

(iv) A relief granted upon demonstration of acceptable operation from an operating restriction that was imposed because acceptable operation was not yet demonstrated. This assumes that the operating restriction and the criteria to be applied to a request for relief have been established in a prior review and that it is justified in a satisfactory way that the criteria have been met.

In summary, it has been shown that the proposed deletion of License Condition 2.C.19 does not involve a significant hazard, as discussed in 10CFR50.92. Based on the attached Safety Evaluation, it is concluded that the health and safety of the public will not be endangered by the proposed change.

ATTACHMENT 2

SAFETY EVALUATION

Analysis Methods and Calculated Fuel Rod Gas Gap Radioactive Fission Product Activity Results For Burnups in Excess of 38,000 MWD/MTU

The radioactive fission product activity in the fuel rod gas gap has been calculated for St. Lucie 2 fuel rod average burnups out to 60,000 MWD/MTU. These calculated fuel rod gas gap activities are for use in the fuel handling accident. The fission gas release was calculated using the methods described in Reference 1.

The controlling activity as far as the off-site dose from the fuel handling accident is that for I-131. The release fraction assumed in these analyses is based on the peak power rod history for St. Lucie 2 Cycle 3 shown in Figure 1. This rod power history was generated in such a way that it is expected to bound the fuel rod power histories for future cycles of St. Lucie 2. This data was input to C-E's FATES 3A fuel performance code (Reference 2). The fuel rod radial temperature distributions as a function of rod average burnup and local power levels shown in Figures 2 and 3 were generated by FATES 3A.

Since the analysis was aimed at a determinition of the gas gap activities for the fuel assembly as a whole, the peak rod linear heat rate was multiplied by a factor of 0.955 to scale from the peak rod values to the fuel assembly average values. Also, since the rod power history of Figure 1 is for the axially averaged linear heat rate, the average linear heat rates in the central axial regions of the fuel will be higher. To account for these axial variations in the linear heat rates, the average kw/ft for the rod was assumed to be the value which would exist in nodes 4-17 (i.e. the central rod region axially). The resultant linear heat rates are displayed in Table 1. The calculated gas release fraction from these central axial nodes was assumed to exist over the entire length of the rod. This is conservative since the release fraction from the end nodes (1-3 and 18-20) would be much less than the release fraction based on the higher linear heat rate in the central axial nodes.

To perform these gas gap activity calculations the fuel rod was divided into 6 equal volume radial nodes. Release fractions were then calculated at 43,396, 52,380 and 60,000 MWD/MTU. The fuel temperature used to calculate the release fraction between a burnup of 35,849 and 43,396 MWD/MTU was conservatively taken from the breakpoints shown on Figure 2, where the fuel temperature distribution at the end of this burnup range is shown. The temperatures assumed correspond to 8.38 Kw/ft (see Figure 2). Note that 8 kw/ft could have been used in this calculation (i.e., 8.38 kw/ft multiplied by the 0.955 factor). However, a value of 8.38 kw/ft was assumed for conservatism. The release fraction for each of the the radial regions, and for the radial average over the rod, are shown in Table 2.

Similarly, the fuel temperature used to calculate the release fraction between a burnup of 43,396 and 52,380 MWD/MTU was taken from the break points on Figure 3 and correspond to 6.56 kw/ft (i.e., 6.87 multiplied by the 0.955 factor). The release fractions for the 52,380 MWD/MTU burnup were calculated in the same manner as described for the 43,346 MWD/MTU burnup based on these data. The resultant release fractions are shown in Table 3. The rod radial average release fraction was calculated to be 4.83×10^{-3} as shown on Table 3.

To determine the corresponding release fractions over the interval between 52,380 and 60,000 MWD/MTU it was assumed that the fuel temperatures from the 52,380 MWD/MTU time point also apply at 60,000 MWD/MTU. (Note that this sort of extrapolation was necessary to extend the available data.) The 52,380 MWD/MTU time point data is judged to be conservative anyway since the fuel and clad will be in contact by 52,380 MWD/MTU. Therefore, the temperatures at a given kw/ft, and the kw/ft value itself, would not be expected to change significantly between 52,380 and 60,000 MWD/MTU. Based on these engineering judgements, and a kw/ft value of 6.30 (i.e., the assumed kw/ft is the 6.54 kw/ft value shown on Figure 3 multiplied by the 0.955 factor discussed above), the 60,000 MWD/MTU release fractions were calculated. The calculated release fractions at 60,000 MWD/MTU are shown in Table 4. The rod radial average release fraction was calculated to be 4.65×10^{-3} as shown in Table 4. It should be noted that this release fraction is not as much lower than the one at 52,380 MWD/MTU as one would expect based on the 0.24 reduction in kw/ft. This is the case because the enhanced fission gas release at the higher burnup essentially negates the benefit of the kw/ft reduction.

The I-131 inventory quoted in the St. Lucie 2 FSAR was calculated based on 10.08 KW/ft rather than the linear heat rates used in these analyses. The lower linear heat rates reduce the inventory for the 8.1 day I-131 to 83 percent of the FSAR values by the 43,396 MWD/MTU burnup. As a result, the I-131 source-term is reduced to an equivalent release fraction of 3.02×10^{-2} by 43,396 MWD/MTU. This release fraction is a factor of 3.3 less than in the FSAR source term. The release fractions at the higher burnups are an even smaller fraction of the FSAR value. For instance, at 60,000 MWD/MTU, the I-131 release fraction is about a factor of 23 smaller than the value quoted in the FSAR.

In conclusion, this analysis has demonstrated that the existing St. Lucie 2 FSAR gas gap activities conservatively bound those for fuel assembly burnups out to 60,000 MWD/MTU.

References:

1. "Method for Calculating the Fractional Release of Volatile Fission Products from Oxide Fuel," ANSI/ANS-5.4-1982.

2. CEN-161(B)-P, "Improvements to Fuel Evaluation Model," Combustion Engineering, Inc., July 1981.

TABLE 1

ST. LUCIE 2, CYCLE 3 POWER FALL OFF HISTORY
ASSUMED IN THESE GAS GAP ACTIVITY ANALYSES

ROD AVG BURNUP	LOCAL LINEAR HEAT RATE			
MWD/MTU	KW/FT			
NODES	1,20*	2,19	3,18	4-17
29057	5.47	7.74	8.50	8.92
33962	5.47	7.74	8.50	8.92
35849	5.36	7.58	8.33	8.74
43396	5.14	7.27	7.99	8.38
45283	4.98	7.04	7.73	8.11
47170	4.76	6.73	7.39	7.76
49057	4.54	6.42	7.05	7.40
50943	4.32	6.11	6.71	7.04
52830	4.21	5.96	6.54	6.87
54717	4.16	5.88	6.46	6.78
56604	4.10	5.80	6.37	6.69
60000	4.05	5.73	6.29	6.60

*Nodes 1 and 20 are at the fuel rod ends.

TABLE 2

RELEASE FRACTIONS AT 43396 MWD/MTU

Radial Region	Release Fraction
1	1.53(-1)*
2	5.74(-2)
3	5.92(-3)
4	1.55(-3)
5	2.06(-4)
6	1.63(-4)**
Average	3.64(-2)

* power of ten

** This is the calculated low temperature release which is higher than the calculated diffusion release fraction.

TABLE 3

Release Fractions of 52,830 MWD/MTU

Radial Region	Release Fraction
1	2.25 (-2)*
2	4.50 (-3)
3	1.35 (-3)
4	3.01 (-4)
5	1.63 (-4)**
6	1.63 (-4)**
Average	4.83 (-3)

* Power of ten.
** This is the calculated low temperature release which is higher than the calculated diffusion release fraction.

TABLE 4

Release Fractions at 60,000 MWD/MTU

Radial Region	Release Fraction
1	2.04 (-2)*
2	5.48 (-3)
3	1.26 (-3)
4	4.22 (-4)
5	1.63 (-4)**
6	1.63 (-4)**
Average	4.65 (-3)

* Power of ten.
** See explanation in Table 1.

FIGURE 1

ST LUCIE 2, CYCLE 3, POWER HISTORY

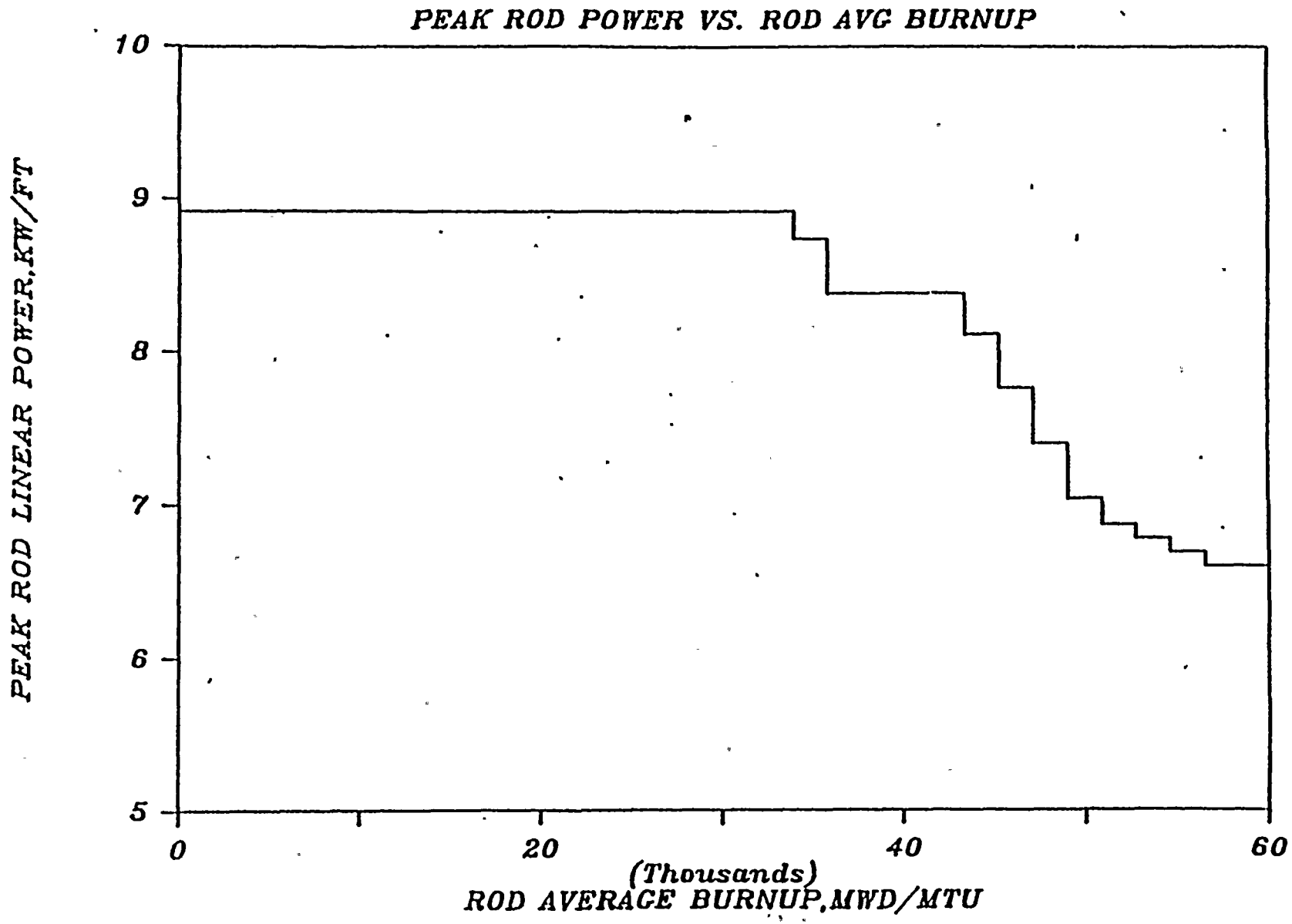


FIGURE 2

ST LUCIE 2, CY 3 FUEL TEMPERATURE

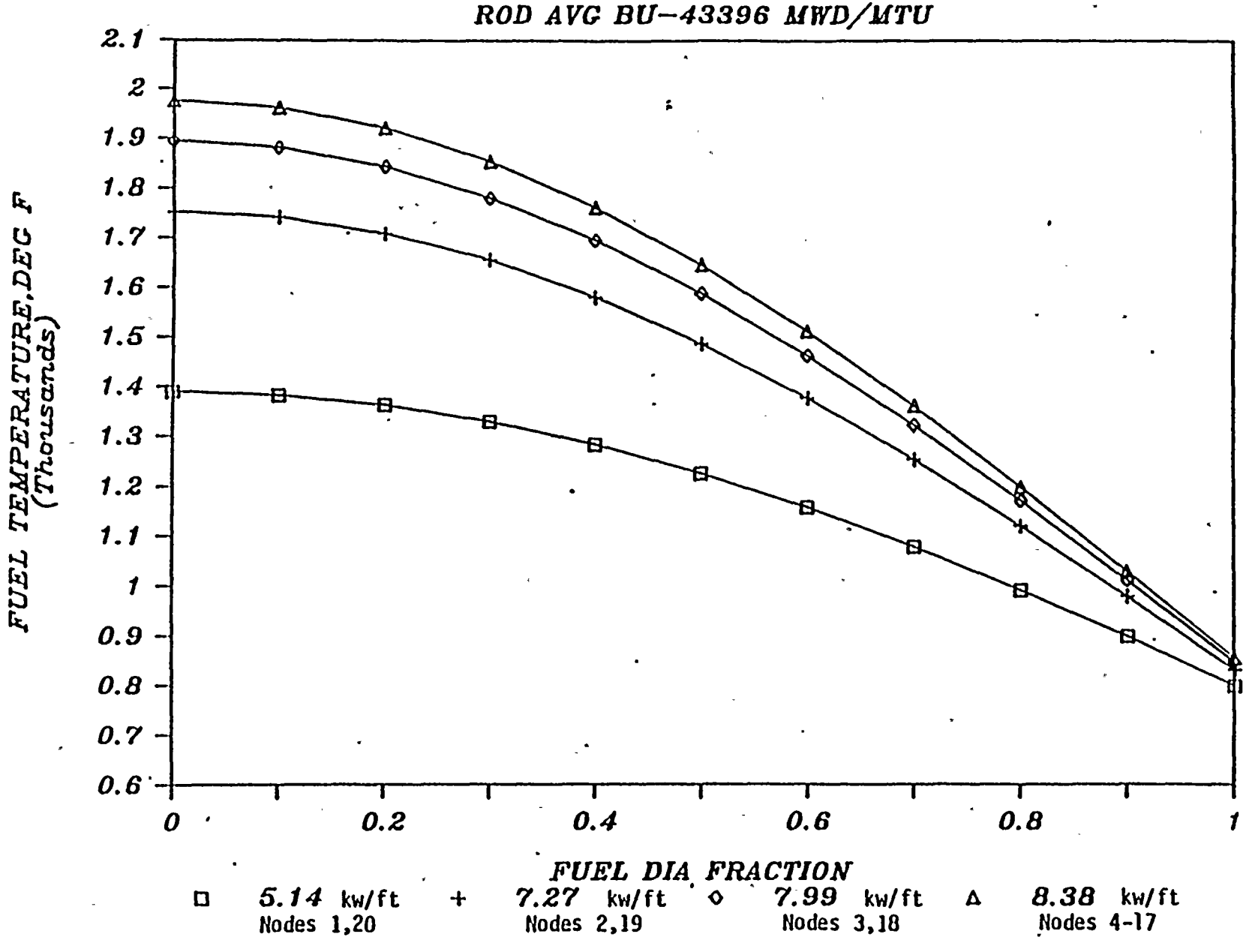
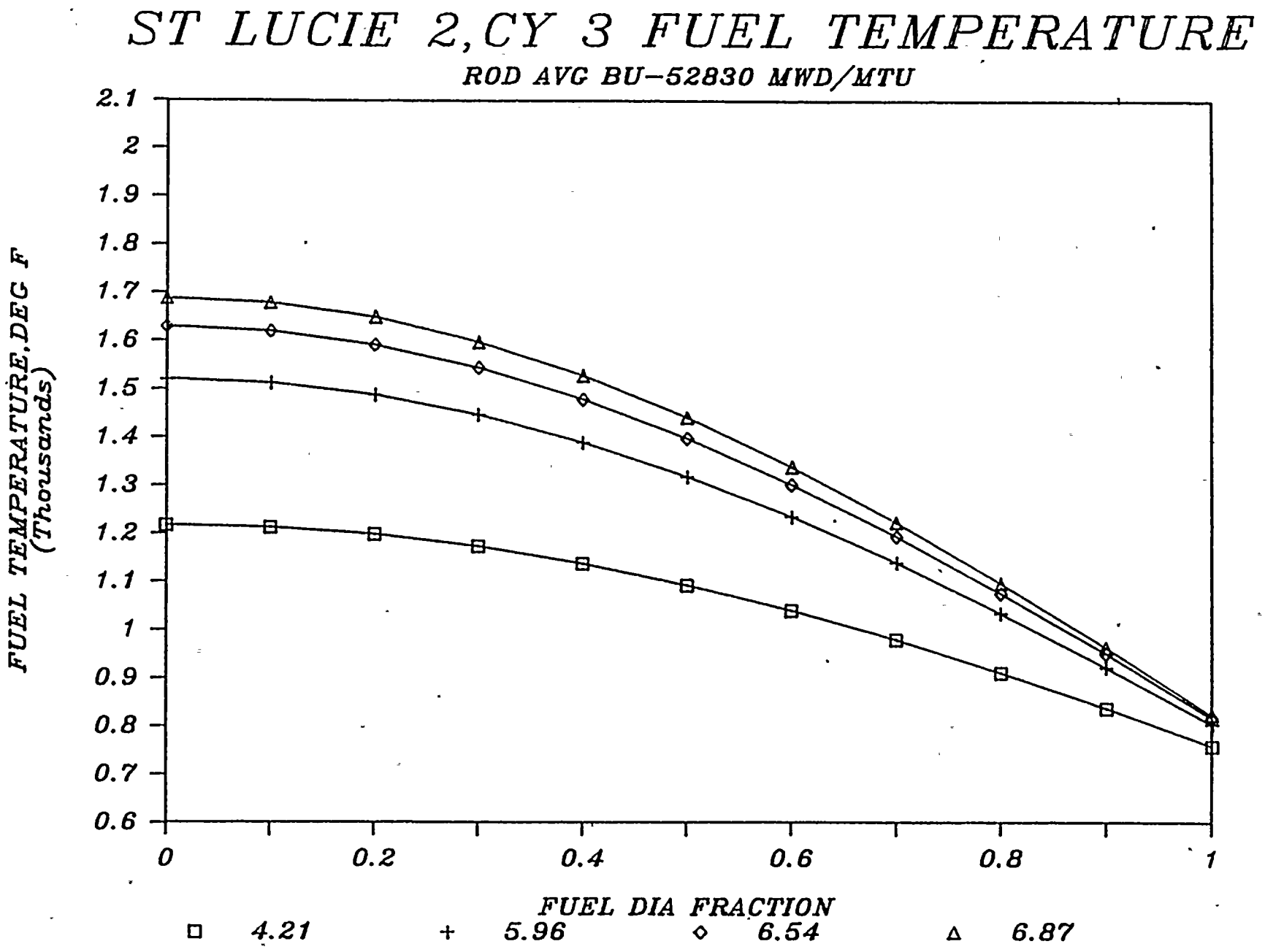


FIGURE 3


ST LUCIE 2,CY 3 FUEL TEMPERATURE
ROD AVG BU-52830 MWD/MTU
FUEL TEMPERATURE,DEG F
(Thousands)
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0
0.2
0.4
0.6
0.8
1
FUEL DIA FRACTION
4.21
5.96
6.54
6.87

PROPOSED OPERATING LICENSE CONDITION AMENDMENT